This document contains the Comprehensive Conservation and Management Plan for Narragansett Bay, December 1992: Source Reduction: Nutrients, and Source Control: Water Management and Wastewater Treatment.

*The report (*narragansett_ccmp_pt5.pdf*) can be downloaded from:*

http://www.epa.gov/owow/estuaries/ccmp/documents/narragansettbay.html

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December 1992

04-01-02 Source Reduction: Nutrients

Objective for the Reduction of Nutrient Inputs

The State of Rhode Island and the Commonwealth of Massachusetts should manage point and nonpoint sources of nutrients to the Narragansett Bay watershed in order to prevent eutrophication and to minimize undesirable nutrient-related effects to Narragansett Bay and its tributaries, and reduce loadings where nutrient-related water quality impacts have been demonstrated.

Introduction

Nutrients are essential for plant and animal growth. The availability of two such nutrients, nitrogen and phosphorus, may limit plant growth in aquatic systems. In freshwater, phosphorus is generally thought to be the limiting nutrient; in most marine and estuarine waters, the limiting nutrient is nitrogen (Penniman *et al.*, 1991b:1). When introduced into aquatic systems in excessive amounts, however, these nutrients may cause a variety of detrimental effects. One such effect is the rapid growth of microscopic algae (*i.e.*, phytoplankton), seaweeds, or other aquatic plants. Decomposition of this organic matter by bacteria may consume enough oxygen in the water to cause fish kills or other detrimental effects on the biota. There may also be more subtle impacts, such as changes in the numbers and types of species living on and in the bottom sediments or in the water column (Penniman *et al.*, 1991b:1-2, 6).

Anthropogenic loadings of excessive nutrients arise from both point (*e.g.*, principally wastewater treatment facilities) and nonpoint sources (*e.g.*, septic systems, fertilizers, animal wastes, and atmospheric deposition). Because phosphorus is the limiting nutrient in freshwater environments and nitrogen in marine and estuarine systems, control strategies will depend upon whether the receiving waters are fresh or saline (Penniman *et al.*, 1991b:6).

Statement of the Problem

The impacts of excessive nutrient loadings to aquatic systems in the Narragansett Bay watershed are determined, in great part, by the sources of the nutrient loads, the hydrographic characteristics of the receiving waters, and whether the receiving waters are fresh or saline. Thus, the Providence-Seekonk River and parts of the Blackstone and Pawtuxet rivers have displayed periodic low dissolved oxygen concentrations measured during a number of surveys over a period of many years (Penniman *et al.*, 1991b:13-23). The low dissolved oxygen concentrations in the Providence-Seekonk region have contributed to detrimental changes to the community of organisms living on the bottom of the river (Germano *et al.*,1992) and have periodically resulted in fish kills, at least historically. Most recently (August 1991) lowered dissolved oxygen concentrations were observed throughout the Providence-Seekonk River in the Upper Bay as far south as Rocky Point-Rumstick Point (McKenna, 1991:1-2). Other regions of the Bay that periodically and, increasingly, have experienced low dissolved oxygen concentrations include Greenwich Bay, Mount Hope Bay, Apponaug Cove, and several other poorly flushed embayments around the Bay (Penniman *et al.*, 1991b:13-23; Dettmann *et al.*, 1992).

Riverine and wastewater treatment facility (WWTF) inputs are the major sources of nitrogen to the Providence-Seekonk River and Upper Narragansett Bay (Oviatt, 1980; Metcalf & Eddy, Inc., 1991b; Penniman *et al.*, 1991b:2, 24). In other areas, like many of the small coves along the shores of Narragansett Bay where there are no direct WWTF discharges, nonpoint sources are the primary contributors. These nonpoint sources include fertilizers that are washed overland by stormwater or leached to the groundwater, nutrients from functional and failed septic systems that are carried either by stormwater or groundwater flow, and nitrogenous compounds in the atmosphere—the combustion products of gasoline and other fossil fuels—that are deposited by precipitation (Penniman *et al.*, 1991b:2).

In homes served by on-site sewage disposal systems (OSDS), high-phosphate laundry detergents may be responsible for half of the phosphorus loadings to the septic systems, while garbage disposals may contribute significantly to biochemical oxygen demand (BOD) and suspended solids (EPA, 1980; EPA, 1991a; Penniman *et al.*, 1991b:55). It should be noted that low phosphate detergents are readily available, and that Indiana, Maryland, Michigan, Minnesota, New York, and Wisconsin currently have restrictions on the phosphate content of laundry and/or dishwasher detergents. The extent of phosphorus (*i.e.*, phosphate) movement in groundwater is limited under most conditions by natural soil processes. The contact time for the effluent in unsaturated soil (determined largely by percolation characteristics and OSDS hydraulic loading rates) and the age of the system influences the effectiveness of phosphate removal. Excessive, long-term loadings can saturate the soils' adsorptive capacity. Additionally, with phosphorus-sensitive waterbodies (*i.e.*, primarily freshwater), even limited additional loadings may cause eutrophication.

Unlike phosphate, nitrogen, in the form of nitrate from OSDS effluent, moves freely through the coarse-textured soils common to much of Rhode Island once it is below the depth where plant roots occur, and is only attenuated by dilution with surrounding groundwater. Since nitrate can travel significant distances in groundwater (*e.g.*, at least 330 feet, Penniman *et al.*, 1991b: 34), in general only limited biological, physical, or chemical processes will act to attenuate groundwater nitrate. Thus, controls over the numbers of OSDSs in a watershed and OSDS setback requirements reduce total nitrogen loading rates and, to a more limited extent, increase dilution with available groundwater.

Measurements of dissolved inorganic nitrogen and phosphorus and chlorophyll *a* (as an indication of phytoplankton biomass) show elevated concentrations in the Providence River decreasing down-Bay to Rhode Island Sound (Doering *et al.*, 1988a; Doering *et al.*, 1988b; Penniman *et al.*, 1991b:20-21). As described above, the Blackstone and Providence-Seekonk Rivers experience periodic *hypoxic* (low oxygen) and in some cases *anoxic* (no oxygen) conditions due to nutrient and BOD loadings from WWTFs. Greenwich Bay and Mount Hope Bay have had similar incidents of low dissolved oxygen. Potential pollution sources to Greenwich Bay and adjoining coves include the East Greenwich WWTF, stormwater runoff, OSDSs, and boats (Penniman *et al.*, 1991b:3, 18).

Wherever water circulation is restricted and vertical stratification of the water column occurs, nutrient loadings may be particularly critical in causing low dissolved oxygen concentrations. Following an algal bloom, the replenishment of the oxygen taken out of the water by bacterial decomposition may be limited to the upper layer of water, where photosynthesis and re-aeration from the atmosphere occur. Lower layers may tend toward anoxic conditions. The problem is particularly acute in the summer, because warm water holds less oxygen than cold water (Penniman *et al.*, 1991b:3-4). Poorly flushed embayments subject to this phenomenon include Apponaug Cove; vertically stratified waters occur in the Providence-Seekonk River (Penniman *et al.*, 1991b:8).

Greenwich Bay and adjacent coves have been demonstrated to have degraded benthic habitats and communities, possibly attributable to high organic and nutrient loadings from anthropogenic sources. Several coves around Greenwich Bay suffer from seasonally-persistent low dissolved oxygen concentrations, algal blooms, and fish kills (Germano and Rhodes, 1989; RIDEM, 1990a; Nowicki and McKenna, 1990). In addition, Greenwich Bay was the locus of the brown tidal algal blooms that occurred in 1985 and 1986 (Smayda, 1988, 1989; Nowicki and McKenna, 1990; Penniman *et al.*, 1991b:49).

A study jointly funded by the Narragansett Bay Project (NBP) and the U.S. Environmental Protection Agency (EPA) in 1986 found that the East Greenwich WWTF was a major source of BOD and suspended solids to Greenwich Cove, and because of circulation patterns, could also affect Greenwich Bay (Frithsen *et al.*, 1987;

Dettmann *et al.*, 1989; Nowicki and McKenna, 1990). This study was performed prior to an upgrade of the East Greenwich WWTF. However, population growth in East Greenwich has already exceeded projections for the year 2010, suggesting that the Town's wastewater facility will continue to be a significant source of nitrogen, phosphorus, and BOD to Greenwich Cove and Greenwich Bay (Penniman *et al.*, 1991b:49). Metcalf & Eddy, Inc., in a study commissioned by the NBP in 1990, assessed several options for upgrading the East Greenwich treatment facility, but concluded that further study was necessary to assess the impacts of any changes (Metcalf & Eddy, Inc., 1991c).

It also needs to be determined whether additional sewering is necessary to mitigate water quality problems associated with failed or failing OSDSs in the Greenwich Bay basin. A preliminary basin plan will be developed by the Rhode Island Department of Environmental Management (RIDEM), the Rhode Island Coastal Resources Management Council (CRMC), the NBP, and local governments pursuant to an interagency agreement executed in November 1990 to assess the situation and recommend the appropriate technological and land use controls (Penniman *et al.*, 1991b:49-50). The preliminary Greenwich Bay basin plan and the subsequent Greenwich Bay Special Area Management (SAM) Plan should use existing local comprehensive land use and facilities plans to help identify areas where sewering may be required in order to alleviate impacts from existing, sub-standard septic systems.

Existing Policies

WWTFs

In general, wastewater treatment facilities (WWTFs) do not have specific permit limits for nutrients. Primary and secondary WWTF effluents are regulated for BOD, suspended solids, and other conventional and toxic pollutants. In other words, conventional wastewater treatment is primarily concerned with reducing BOD and suspended solids in the final effluent, and not eutrophication of receiving waters due to excessive loadings of nutrients (Penniman *et al.*, 1991b:13, 27).

Septic Systems

Current OSDS regulations in Rhode Island affect septic system location, design, installation or alteration, and maintenance. Determination of site suitability includes such factors as location relative to wetlands, surface water bodies and drinking water supplies, slope, type of soil, percolation tests, maximum groundwater elevation, and occurrence of impervious formations. There are special regulations for sensitive areas, such as lateral setbacks of 150 feet within coastal erosion-prone areas and the Narrow River and coastal pond watersheds, and 200 feet in the Scituate Reservoir watershed (RIDOA, 1990a). However, there is no requirement within current regulations that percolation tests performed in determining subdivision delineations correspond with final location of OSDSs on individual lots (Penniman *et al.*, 1991b:52).

The CRMC has encouraged the use of alternative septic system designs in certain unsewered areas where nitrogen loadings from domestic waste would be a problem. The CRMC has required the installation of denitrifying RUCK systems in the salt pond region of southern Rhode Island, for example. The homeowner might also be required to install a standard OSDS as a back-up in the event of failure of the alternative system (Penniman *et al.*, 1991b:35).

To ensure routine inspection and maintenance of both conventional and alternative septic systems, as well as adequate septage disposal capacity, the State of Rhode Island passed enabling legislation in 1987 allowing municipalities to establish wastewater management districts (WWMDs) (RIDOA, 1987; Penniman *et al.*, 1991b:36). Although no WWMDs have been formed to date (1991), three towns—Hopkinton, Narragansett, and Jamestown—have begun developing WWMD ordinances (Penniman *et al.*, 1991b:54).

Analysis

Effective long-term management of nutrient loadings to surface waters is best approached from a watershed-level perspective. CRMC's SAM Plan process represents one effective vehicle for managing nutrient inputs via land use and density controls. There are, however, a number of approaches for controlling nutrient loadings on a watershed (or subwatershed) basis. (Penniman *et al.*, 1991b: 33-40) For example, the Buzzards Bay Project (1990) has established a subwatershed approach to control nitrogen loadings to nutrient-sensitive waterbodies by setting limits on OSDS density based upon modelled loadings that would achieve a "critical nutrient loading limit" designed to protect the receiving waters from eutrophication (Buzzards Bay Project, 1990; Monahan *et al.* 1991). OSDS density controls are also proposed as one of the "management practices" in the *Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* (EPA, 1991a:4-40 to 4-41). Therefore, the state's Coastal Nonpoint Pollution Control Program (CNPCP), that will be developed jointly between CRMC and RIDEM as required by Section 6217 of the 1990 Amendments to the Coastal Zone Management Act or CZMA (EPA, 1991a; NOAA/EPA, 1991), may include enforceable watershed-based mechanisms to limit the cumulative impact of nitrogen loading to coastal waters from OSDS. [Note: A more detailed discussion of the CNPCP, required by Section 6217 of the 1990 Amendments to the CZMA, is presented in 04-01-07: Source Reduction: Nonpoint Sources.]

Another mechanism to control nutrient loads is through the establishment of total maximum daily loads (TMDL) and associated waste load allocations (WLA) (EPA, 1991a). For example, in cases where excessive nutrient loads cause eutrophication and/or loss of fish or wildlife habitat in spite of discharger compliance with technology-based requirements, water-quality based controls may be required in order to achieve desired uses (*e.g.*, Providence-Seekonk River). In such cases, the state must determine the amount of nutrients or BOD that the waterbody can assimilate and meet water quality standards (*e.g*,, dissolved oxygen). The amount of pollutant that the waterbody can assimilate is called the TMDL. Based upon the TMDL, permissible loads from both point and nonpoint sources are calculated. The TMDL is then allocated among point and nonpoint sources based upon WLA (for point sources) and load allocations or LA (for nonpoint sources).

The State of North Carolina has established a statutory definition of "nutrient-sensitive waters" (NSW) as "waters that are experiencing or are subject to excessive growth of microscopic or macroscopic vegetation .... [which will] ... substantially impair the use of the water for its best usage..." Designation as NSW requires the development and implementation of a nutrient management strategy. The North Carolina Environmental Management Commission designated the 5,400 square mile Tar-Pamlico River basin as nutrient-sensitive waters in September 1989. The implementation of the nutrient reduction/control strategy includes a "nutrient-trading" strategy between point source (*e.g.*, WWTFs) and nonpoint source (*e.g.*, farmers) dischargers of nitrogen and phosphorus. Interim nutrient reduction goals have been established prior to the development of a TMDL and water quality model for the Tar-Pamlico River estuary.

On the other hand, while taking a watershed-wide approach, care should be taken not to trivialize localized impacts, especially near major point sources and in subembayments where tidal flushing is limited. Assessments of loadings and their effects and the development of mitigation strategies must focus on areas of demonstrated impacts, or where future conditions such as population growth or land use changes are likely to degrade water quality (Penniman *et al.*, 1991b:7-8).

Water Quality Criteria vs. Waste Load Allocation Models

Water quality standards are based on the water quality criteria necessary to maintain a waterbody's designated uses (*e.g.*, fishing, swimming, or fish and wildlife habitat). However, as mentioned above, no nutrients water quality criteria have been promulgated nationally that specifically protect aquatic organisms from the effects of eutrophication and other impacts of excessive nutrients (Penniman *et al.*, 1991b:13). In addition, at present, EPA can only establish nutrients loadings limits for dischargers if the need for nutrient removal has been demonstrated empirically by evidence of hypoxia, anoxia or other indicators of eutrophic conditions in the receiving water, *and* the basis for nutrient loadings reductions has been apportioned via a WLA.

A WLA is a mathematical model that relates pollutant loadings, *e.g.*, nutrient and BOD loadings, to the maintenance of minimum in-stream water quality criteria, *e.g.*, dissolved oxygen levels. The model is used to establish WWTF discharge limits for BOD and, if necessary, nutrients, in order to achieve the desired dissolved oxygen concentrations in the receiving water. The RIDEM has conducted a WLA for the Pawtuxet River, for example, and assigned more stringent effluent limits for BOD to the Cranston, Warwick, and West Warwick WWTFs (Penniman *et al.*, 1991b:4). However, the WLA approach does not account for ecological impacts of excess nutrient additions other than those related directly to dissolved oxygen concentrations. In addition, the WLA approach is reactive rather than proactive since it is only applied after evidence of a negative environmental impact already exists.

Protective aquatic life criteria should be developed for nutrients in order to enable federal, state and local regulatory agencies to govern future sources of nutrients to receiving waters before evidence of eutrophication occurs. These criteria should go beyond simply establishing threshold concentrations of nutrients in the water column since these concentrations may have little relationship to the existence of, or potential for, eutrophic conditions. For example, phytoplankton and seaweeds rapidly take up and recycle available nitrogen, leaving low nutrient concentrations in the water column itself but potentially resulting in nuisance algal blooms. Therefore, to accurately assess and limit the potential for eutrophication, it may be more appropriate to set nutrient loading limits rather than water column concentrations as standards (Buzzards Bay Project, 1990; Penniman *et al.*, 1991b:13).

Any chemical-specific criteria that would apply could be complemented by biological criteria. The EPA has issued guidance for states to develop biological criteria to incorporate into state water quality standards (EPA, 1990). These criteria may be numerical values (*e.g.*, indices of community structure), narrative descriptions of aquatic communities, or characteristics of unimpaired waters to be compared with other waterbodies (Penniman *et al.*, 1991b:44). By utilizing a biological or community descriptor, biological criteria can provide better detection of impairment resulting from unknown types or sources of pollutants or the synergistic effects of individual pollutants, in a similar fashion to whole effluent toxicity testing. Biological criteria should be particularly useful in detecting eutrophication and other nutrient-related impacts—that is, in addition to lowered dissolved oxygen—from point or nonpoint sources (Penniman *et al.*, 1991b:44).

Recommended Policies and Actions and *Estimated Cost of Implementation* are presented in the following pages.

RECOMMENDED POLICIES AND ACTIONS
SOURCE REDUCTION: NUTRIENTS

CODE	POLICY	AGENCIES	STATUS
I.	Point source loadings of nutrients to Narragansett Bay should be reduced where receiving water impacts from nutrients have been demonstrated. Increases in point source loadings of nutrients to Narragansett Bay should be minimized to prevent eutrophication and undesirable nutrient-related effects to Narragansett Bay and its tributaries.		
I.A.	The U.S. Environmental Protection Agency (EPA) should establish protective aquatic life water quality criteria and/or annual loading criteria for eutrophication and related impacts from nitrogen and phosphorus to fresh, estuarine, and marine receiving waters by January 1994. Any nutrient-related criteria should be more inclusive of ecosystem function than merely simple water column concentration of either phosphorus or nitrogen. 1. The EPA should provide guidance for the states to adopt biological criteria for the detection and regulation of nutrient (*i.e.*, nitrogen and phosphorus) loadings impacts upon fresh, marine, and estuarine receiving waters. The proposed biological criteria should be more sensitive to nutrient specific effects than, for example, simple benthic community composition. 2. Once established these criteria should be considered for incorporation by the State of Rhode Island and the Commonwealth of Massachusetts into their Coastal Nonpoint Source Programs developed pursuant to Section 6217(g) of the Coastal Zone Management Act Reauthorization Amendments of 1990 in order to assist in delineating "critical coastal areas", as defined in *Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance* (EPA, 1991a:1-20).	EPA, NOAA, RIDEM, CRMC, MADEP, MACZM	[See EPA/ ERL, Narragansett. "Preliminary Agreement," Section 715-05-06 re: development of nutrient criteria for marine waters.]
I.B.	The EPA should establish enforceable nutrient effluent limits for wastewater treatment facilities (WWTFs) based upon removal efficiencies achievable by best achievable technology (BAT) for secondary and tertiary wastewater; and should require WWTF influent and effluent monitoring of nitrogen and phosphorus.	EPA	

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I.C.	Based upon the results of the Narragansett Bay Project-sponsored *Dissolved Oxygen Model of the Providence-Seekonk River* (Dettmann *et al.*, 1992), the Rhode Island Department of Environmental Management (RIDEM) and EPA should prepare a waste load allocation (WLA) of nutrients for point source dischargers to the Providence-Seekonk River and require loadings reductions, if necessary, to achieve dissolved oxygen water quality standards.	RIDEM, EPA	NBP-sponsored Eutrophication Screening Model completed, June 1992. [See EPA/ERL, Narragansett, RIDEM "Preliminary Agreements," Section 715-05-06 re: Providence River WLA.]
I.D.	The EPA, the Massachusetts Department of Environmental Protection (MADEP), and RIDEM should conduct synoptic dry weather and wet weather water quality surveys of the Blackstone River in order to: 1. Help identify the relative importance of nutrient loadings from point source discharges, runoff, and sediment resuspension utilizing water quality modelling methodology. 2. Use that modelling to prepare a WLA of nutrients and biochemical oxygen demand (BOD) for point and nonpoint source dischargers to the Blackstone River system based upon any demonstrated violations of dissolved oxygen water quality criteria in the Blackstone or impacts to the Providence-Seekonk River.	EPA, RIDEM, MADEP	[See EPA Region I "Preliminary Agreement," Section 715-05-06 re: DO-BOD-nutrients modeling on the Blackstone River.]
I.E.	As part of the implementation of advanced waste treatment for Warwick, West Warwick, and Cranston WWTFs, RIDEM and the WWTFs shall conduct a monitoring program to verify that compliance with the final Rhode Island Pollutant Discharge Elimination System (RIPDES) effluent limits is sufficient to meet water quality standards for the Pawtuxet River. If these BOD limits are insufficient to meet water quality standards for dissolved oxygen, RIDEM should consider establishing nutrient effluent limits for these WWTFs.	RIDEM, Warwick WWTF, W.Warwick WWTF, Cranston WWTF	[See RIDEM "Preliminary Agreement," Section 715-05-06 re: Pawtuxet River monitoring.]

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I.F.	Greenwich Bay		
I.F.1.	In order to alleviate low dissolved oxygen concentrations in Greenwich Bay, the EPA, RIDEM, and the East Greenwich WWTF should conduct a WLA for point and nonpoint sources to Greenwich Bay when the RIPDES permit for the East Greenwich WWTF is renewed in 1993.	EPA, RIDEM, E. Greenwich WWTF	[See EPA Region I "Preliminary Agreement," Section 715-05-06.]
I.F.2. ✓	**The Rhode Island Coastal Resources Management Council (CRMC), the RIDEM, and other state and local planning and implementation authorities should develop a Special Area Management (SAM) Plan for the Greenwich Bay region. Data collected by the NBP and others, including an engineering review of wastewater management infrastructure in the basin and local comprehensive and facility siting plans should be used to the maximum extent possible in preparing the SAM Plan. The SAM Plan should address:** **a. Both major point and nonpoint sources of pollution to Greenwich Bay;** **b. The long-term need for sewering in the basin to alleviate nonpoint source pollution relating to septic systems;** **c. The needs for sewering related to existing and projected population growth;** **d. Long-term management of the Greenwich Bay shellfish resource; and** **e. Capital costs associated with implementation of the SAM Plan and sources of federal and state funding available for implementation.**	**CRMC, RIDEM**	**$150,000 may be available for preliminary basin plan pursuant to RIDEM-CRMC-NBP Interagency MOA. [See RIDEM "Preliminary Agreement," Section 715-05-06.]**

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II.	Land use activities along the shores of Narragansett Bay and all nutrient-sensitive tributary waters and wetlands within the Narragansett Bay basin should be required to provide for management of nutrient loadings to receiving waters.		
II.A.	The State of Rhode Island, the Commonwealth of Massachusetts, and local municipalities should adopt consistent policies in the Narragansett Bay watershed to control on-site sewage disposal system (OSDS) densities at the subwatershed level in order to minimize nitrogen loadings (*i.e.*, dissolved inorganic nitrogen) to marine and estuarine waters. The recommendation should be implemented in sequence as described below.		
II.A.1.	The RIDEM, CRMC, MADEP, and Massachusetts Coastal Zone Management (MACZM) should delineate all nutrient-sensitive waters (and associated subwatersheds) in the Narragansett Bay basin. Possible criteria to be used in delineating nutrient-sensitive waters include: 1) poorly flushed coastal embayments, 2) waterbodies subject to summer vertical stratification, 3) waterbodies with large watershed areas relative to the receiving waterbody area, 4) waterbodies experiencing water column or sediment hypoxia or anoxia, and/or 5) waterbodies experiencing excessive growth of microscopic or macroscopic vegetation, and/or fish kills.	RIDEM, CRMC, MADEP, MACZM	
II.A.2.	The RIDEM and MADEP, in conjunction with the Rhode Island Division of Planning (RIDOP), CRMC, MACZM, and local governments (as appropriate), should require minimum two acre zoning to control OSDS density in currently unplatted areas. Cluster development should be strongly encouraged to attain the nitrogen-loading equivalent of a two acre OSDS density for the number of units considered. In addition, RIDEM and MADEP, in conjunction with CRMC and MACZM, should develop design and performance standards for alternative OSDS technologies to be required for use in all subwatersheds of nutrient-sensitive waters in order to minimize the cumulative impact of nutrient inputs to the receiving waters. [*Note*: The prescriptive OSDS density controls and setback requirements are interim measures to be used until the site-specific density controls recommended in II.A.3 (below) are developed.]	RIDEM, MADEP, RIDOP, CRMC, MACZM, municipalities	See 04-01-05 Source Control: On-site Sewage Disposal Systems.

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II.A.3.	The EPA, RIDEM, MADEP, CRMC, and MACZM should evaluate the effectiveness of existing approaches to control OSDS density based upon nitrogen loading and provide funding to develop and test a model ordinance for the Narragansett Bay watershed. The model should use site-specific criteria (*e.g.*, soils, watershed and receiving water characteristics) to the greatest extent possible. [The model developed by the Buzzards Bay Project should be evaluated for application in the Narragansett Bay watershed.]	EPA, RIDEM, MADEP, CRMC, MACZM	[See EPA Region I "Preliminary Agreement," Section 715-05-06 re: workshops on nitrogen management.]
II.B.	The OSDS setback distance should be increased to a standard minimum distance in unplatted areas adjacent to critical resources, including identified nutrient-sensitive waterbodies. The OSDS setback distance on existing lots of record in nutrient-sensitive watersheds should be increased to a minimum of 75 feet up to the maximum possible distance. The Rhode Island OSDS (as ISDS) Regulations (RIDEM 1989f) should be revised to: 1. Ensure that water level verification and percolation tests be performed on a lot-by-lot basis coincident with the location of the individual OSDS systems after individual lots are delineated; and 2. Provide a procedure for an applicant to seek a variance from the setback requirements if evidence of no significant impact from additional nutrient loading to adjacent waterbodies can be demonstrated based on site-specific data.	EPA, RIDEM, MADEP, CRMC, MACZM	See 04-01-05 Source Control: On-site Sewage Disposal Systems
II.C.	Best management practices for nutrient control		
II.C.1.	The State of Rhode Island should adopt the *Rhode Island Soil Erosion and Sediment Control Handbook*(RIDEM, 1989e) and *Rhode Island Stormwater Design and Installation Standards Manual* when completed (Boyd, 1991) as required best management practices (BMP) within the Narragansett Bay watershed to the extent that these practices are at least as protective as the "management measures" presented in the final *Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* (EPA, 1991a).	RIDEM, CRMC, Mass. counterparts	[See USDA SCS "Preliminary Agreement,", Section 715-05-06 re: efforts to establish soil erosion and sediment control regulations in Mass.]

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II.C.2.	In developing BMPs to control pollutants carried by surface water runoff, the "vegetated buffer strip delineation work group" [described in 04-02-02 Resource Protection: Protection of Critical Areas], should consider buffer strips or vegetated filter strips as BMPs based upon <u>all</u> the functions that buffer strips can perform. The "vegetated buffer delineation work group" should emphasize the maintenance of natural, undisturbed riparian areas, as defined in *Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* (EPA, 1991a: 7-2 to 7-3), and should consider all available research results on buffer strip delineation.	RIDEM, CRMC	[See CRMC "Preliminary Agreement," Section 715-05-06.]
II.C.3.	The "vegetated buffer strip delineation work group" [described in 04-02-02 Resource Protection: Protection of Critical Areas] should consider establishing a prescriptive buffer area adjacent to nutrient-sensitive waters where the use of nitrogen and phosphorus-containing fertilizers would be prohibited. In addition, RIDEM, MADEP, MACZM, CRMC, U.S. Department of Agriculture Soil Conservation Service, and State Cooperative Extension Services should produce outreach information to inform the public of the impacts of excessive fertilizer use on aquatic systems, and to discourage fertilizer use near waterbodies and wetlands.	RIDEM, MADEP, MACZM, CRMC, USDA SCS, Cooperative Extensions	[See USDA SCS "Preliminary Agreement," Section 715-05-06 re: development of a state nutrient management program.]
II.D.	The State of Rhode Island and the Commonwealth of Massachusetts should legislatively require the establishment of wastewater management districts (WWMDs) by all municipalities having unsewered areas within the Narragansett Bay watershed by December 1995. Priority should be given to those municipalities bordering nutrient-sensitive estuarine receiving waters.	R.I., Mass.	[See RIDEM "Preliminary Agreement," Section 715-05-06.]
II.E.	The State of Rhode Island and the Commonwealth of Massachusetts should require certification of OSDS tank structural integrity (visually determined by certified septage pumper/hauler and included as part of pumpout receipt), frequency of historical pumping, date of most recent pumping, and history of leach field failure as part of required seller disclosure information.	R.I., Mass.	R.I. Assoc. of Realtors submitted draft "seller disclosure" legislation (HR 8891) in 1992 legislative session.

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II.F.	The State of Rhode Island should ban the retail sale and advertisement of acid and organic chemical solvents for use in septic systems. The Commonwealth of Massachusetts should ban the use, sale, and advertisement of such chemicals. The State of Rhode Island and the Commonwealth of Massachusetts should institute informational campaigns to inform the public of the risk of environmental damage from these products.	R.I., Mass.	
II.G.	The State of Rhode Island and the Commonwealth of Massachusetts should prohibit the sale of laundry detergents containing greater than 0.5 percent elemental phosphorus by weight and dishwashing detergents containing greater than 8.7 percent elemental phosphorus by weight. The RIDEM and MADEP should establish phosphate limits for other commercial detergents, including those used by car washes.	R.I., Mass.	
II.H.	The State of Rhode Island and the Commonwealth of Massachusetts should prohibit the installation of garbage disposal systems in residences and businesses served by OSDSs. RIDEM and MADEP should establish outreach information to inform the public of the relative impacts and waste contributions from residential garbage disposal systems in order to help reduce the use of existing garbage disposals.	R.I., Mass., RIDEM, MADEP	
II.I.	The Rhode Island Solid Waste Management Corporation, the Rhode Island Association of Sustainable Agriculture (RISA), RIDEM and Rhode Island municipalities should encourage efforts by WWTFs to compost sludge, septage, boater septage wastes and yard wastes.	R.I. SWMC, RISA, RIDEM, municipalities	

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III	The State of Rhode Island and the Commonwealth of Massachusetts should support programs to establish a greater understanding of the effects of and processes controlling nutrients in the Narragansett Bay watershed in order to support management of loadings and effects.		
III.A.	The EPA, the Commonwealth of Massachusetts, and the States of Rhode Island, New York, and Connecticut should establish joint monitoring stations in the Rhode Island Sound-Long Island Sound region to provide for baseline information on the oceanic input of nutrients to Buzzards Bay, Narragansett Bay, and Long Island Sound.	EPA, Mass., R.I., N.Y., Conn.	[See EPA Region I "Preliminary Agreement," Section 715-05-06.]
III.B.	The EPA, the National Oceanic and Atmospheric Administration (NOAA), the State of Rhode Island, and the Commonwealth of Massachusetts should support a permanent, comprehensive monitoring program to assess the impact of direct wet and dry atmospheric deposition of nutrients and toxics to the Narragansett Bay watershed.	EPA, NOAA, R.I., Mass.	[See EPA Region I "Preliminary Agreement," Section 715-05-06.]
III.C.	The State of Rhode Island and the Commonwealth of Massachusetts should increase monitoring and assessment of summer low dissolved oxygen concentrations in Mount Hope Bay and the Taunton River and, if necessary, establish and implement nutrient reduction strategies for the Mount Hope Bay watershed. The assessment of nutrient loads to Mount Hope Bay should include possible nitrogen and BOD contributions from the Brayton Point Power Plant cooling water effluent.	MADEP, RIDEM	[See RIDEM. "Preliminary Agreement," Section 715-05-06.]
III.D.	The State of Rhode Island should support a permanent Volunteer Monitoring Program Coordinator within RIDEM with the responsibility, in part, to provide technical support to citizen monitoring programs in Narragansett Bay embayments and tidal rivers in order to achieve more complete monitoring coverage of these areas.	RIDEM	[See RIDEM. "Preliminary Agreement," Section 715-05-06.; and Chapter 05-02-04 Long-term Monitoring.]

✓ - **High Priority Action**

Estimated Cost of Implementation—Source Reduction: Nutrients

Table 715-04(2) summarizes the estimated costs associated with the implementation of this chapter's recommendations. The major costs associated with Element I (Point Sources) are to complete a waste load allocation for nutrients in the Providence-Seekonk River ($150,000) and a water quality model of point and nonpoint sources to Greenwich Bay ($400,000). Major recommended actions that are costed elsewhere include synoptic wet/dry weather water quality surveys (04-03-02 Areas of Special Concern: Blackstone River), a SAM Plan for Greenwich Bay (04-02-02 Resource Protection: Protection of Critical Areas), and monitoring of the Pawtuxet River to verify compliance with NPDES/RIPDES effluent limits (04-01-01 Source Reduction: Toxics). Other costs relate to coordination with other agencies.

The major actions recommended under Element II (Land Use Strategies) are a requirement for the establishment of Wastewater Management Districts (costed under 04-01-03 Source Control: Water Management) and the development of a vegetated buffer guidance (costed under 04-02-02 Resource Protection: Protection of Critical Areas). Other minor costs include the adoption of standards and the creation of legislation prohibiting high phosphate detergents. A recommended requirement for two acre zoning to control OSDS density in the subwatersheds of nutrient-sensitive waters could potentially cause a loss of tax revenue to a municipality as well as having an impact on the profitability of land to landowners. The legislative cost associated with revision of zoning ordinances to Bay watershed municipalities is estimated at $117,500. Monitoring recommendations in Element III (Scientific Understanding) are costed under the Mount Hope Bay (04-03-01) and *CCMP* Governance (715-05-02) chapters.

RIDEM will be responsible for the cost of the major actions recommended in this chapter with some smaller personnel costs to CRMC, MADEP, and MACZM. There will also be coordination activities between these state agencies and federal agencies.

For further details regarding the *CCMP* cost estimation process and funding strategies, refer to the *Narragansett Bay CCMP Cost Estimation and Funding Report*(Apogee Research Inc./NBP, 1992).

Table 715-04(2)

ESTIMATED COST OF IMPLEMENTATION
SOURCE REDUCTION: NUTRIENTS

COST ESTIMATES BY ELEMENT	92-93		93-94		94-95		95-96		96-97		Total 92-97	
	Personnel	Other	Personnel	Other	Personnel	Other	Personnel	Other	Personnel	Other	Personnel	Other
I-Reduce Point Source Loads	0	150,000	0	0	0	400,000	25,000	0	0	0	25,000	550,000
II-Manage Land Use Activities	2,500	0	29,375	0	30,625	0	29,375	0	29,375	0	121,250	0
III-Effects and Processes	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	2,500	150,000	29,375	0	30,625	400,000	54,375	0	29,375	0	146,250	550,000
TOTAL BY YEAR		152,500		29,375		430,625		54,375		29,375		696,250

COST ESTIMATES BY AGENCY	92-93		93-94		94-95		95-96		96-97		Total 92-97	
	Personnel	Other	Personnel	Other	Personnel	Other	Personnel	Other	Personnel	Other	Personnel	Other
RIDEM	1,250	150,000	0	0	1,250	400,000	0	0	0	0	2,500	550,000
RI CRMC	0	0	0	0	0	0	12,500	0	0	0	12,500	0
MADEP	1,250	0	0	0	0	0	0	0	0	0	1,250	0
MACZM	0	0	0	0	0	0	12,500	0	0	0	12,500	0
Municipalities*	0	0	29,375	0	29,375	0	29,375	0	29,375	0	117,500	0
TOTALS	2,500	150,000	29,375	0	30,625	400,000	54,375	0	29,375	0	146,250	550,000
TOTAL BY YEAR		152,500		29,375		430,625		54,375		29,375		696,250

* Ultimate implementation costs will vary for each municipality depending on its particular environmental and institutional conditions. In addition, the estimated municipal implementation costs do not include ultimate program and capital costs that may result from completion of underlying planning activities, or costs that are expected to be completely recoverable from user fees.

04-01-03 Source Control: Water Management and Wastewater Treatment

Objective for Water Management and Wastewater Treatment

The State of Rhode Island should improve the water quality of Narragansett Bay and its tributaries through institutional changes in the organizations responsible for water supply and use, and wastewater treatment and discharge within the Narragansett Bay watershed. The institutional changes should be intended to produce direct water quality benefits or to result in economic or administrative efficiencies which can then be translated into water quality improvements.

Introduction

Water supply, water use, wastewater treatment, and wastewater discharge are fundamentally linked. In most cases, water supply to domestic, commercial, or industrial users is ultimately discharged through a municipal treatment system and discharged to receiving waters. However, the use of water, from supply to ultimate disposal, is typically managed according to the particular location, destination and/or use of the water in question. As a result, the institutional framework used to manage water is extremely complex.

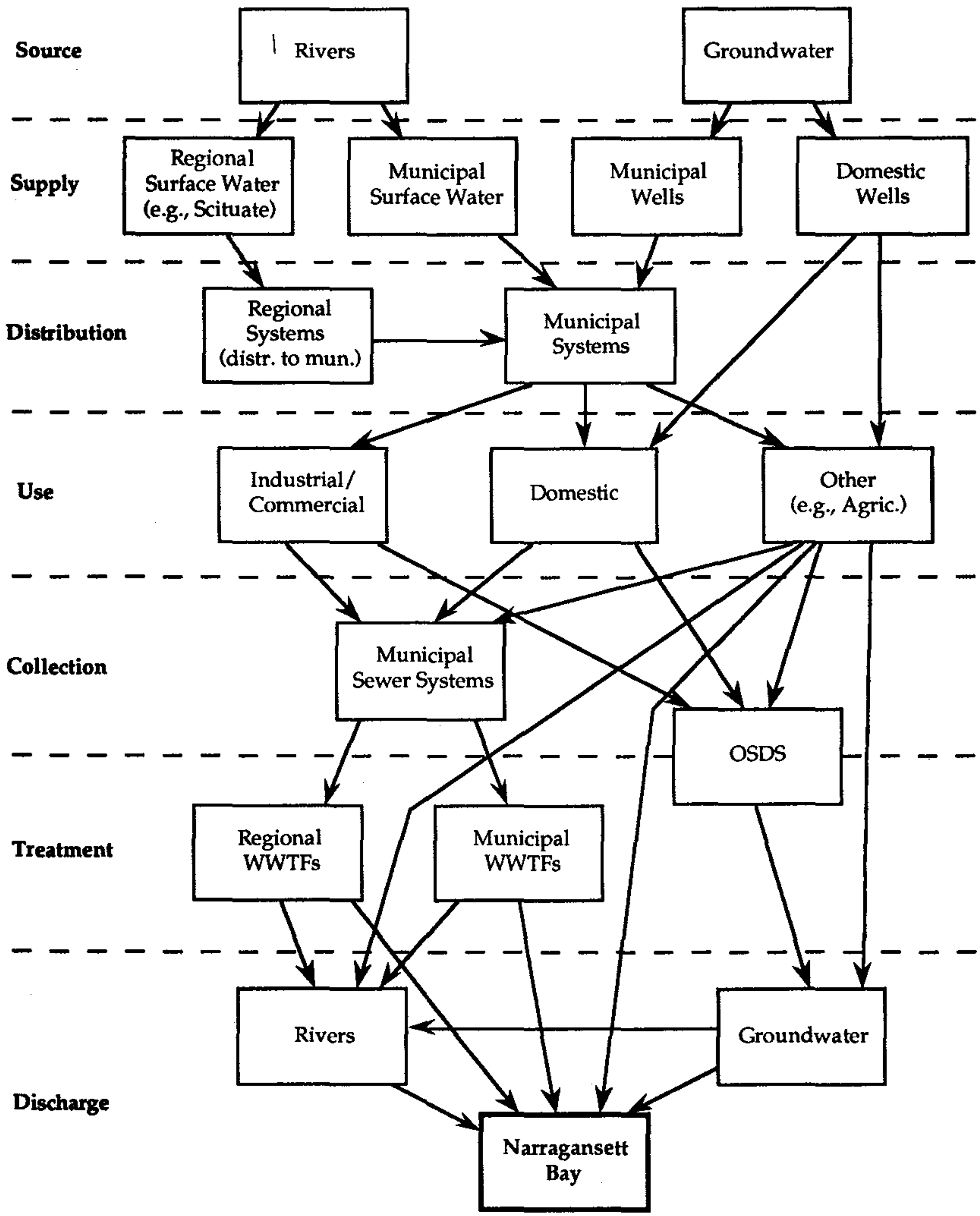
In populated areas, domestic, industrial, commercial, and agricultural water supplies are typically provided through publicly owned or commercial water suppliers, or by on-site wells. This water is then distributed to residential, commercial, and industrial users through municipal distribution systems. "Used" water is subsequently discharged through municipal sewer systems to publicly owned wastewater treatment facilities (WWTFs), or to on-site sewage disposal systems (OSDSs), for treatment and ultimate discharge to a receiving water — such as Narragansett Bay or one of its tributaries. Other water uses such as irrigation, power generation, and cooling may rely on direct withdrawals from surface waters or groundwater, and result in direct or indirect (runoff) discharge to a receiving surface water or groundwater, often without treatment. Figure 715-04(1) shows the many paths that water may take from its source to its ultimate discharge as wastewater (Zingarelli and Karp, 1991:1-2).

In Rhode Island alone, 30 major water suppliers provide the water supply of 90 percent of the state's residents. Many of the major suppliers are regulated by the Public Utilities Commission (PUC), although some of the major suppliers and most of the minor suppliers are not. Municipal sewage collection and conveyance systems are administered by each sewered community in the watershed for the primary purpose of protecting public health and safety and maintaining water quality. However, the municipalities also use sewer plans as a means to manage local growth and development (Zingarelli and Karp, 1991:1).

There are presently 33 WWTFs in the Narragansett Bay watershed, administered by 32 separate regional or municipal sewage treatment authorities in Rhode Island and Massachusetts. (As a result of the recent merger of the Narragansett Bay Commission and the Blackstone Valley District Commission, the Narragansett Bay Commission administers both the Field's Point and Bucklin Point WWTFs.) These sewer authorities have no control over the water supply systems or the OSDSs within their service area, nor do the water suppliers have any control over the treatment authorities.

In addition, local decisions about water supply and wastewater treatment have historically been regulated by different federal, state, and regional agencies, often with overlapping authority. In some cases, regulatory authority over water use, water quality, and wastewater quality is exercised by separate departments or divisions within those agencies (Zingarelli and Karp, 1991:1). Therefore, as described in the following sections, restructuring the institutional framework for managing water could be an important step in improving the water quality of Narragansett Bay and its tributaries (Zingarelli and Karp, 1991:3).

Figure 715-04(1). Path of Water from Source to Discharge



Statement of the Problem

The large number of water suppliers in Rhode Island has historically made statewide water supply planning a difficult task. In addition, the large number of federal, regional, state, and local authorities with responsibility for water supply and wastewater treatment in the Narragansett Bay basin has complicated the state's ability to manage water use and protect water quality. The effects of the existing, decentralized system of regulating water supply and wastewater treatment on water conservation and water quality are discussed below.

Billing Practices *vs.* Conservation

Water use rates used in the Narragansett Bay basin range from an annual flat charge to regular and timely usage-based billing. The price charged for water is often low relative to the true cost of providing the water and, in many cases, billing is infrequent and reflects declining block rates (*i.e.*, the price per gallon decreases as consumption increases). In addition, water meters are often nonexistent, nonfunctioning, or read only sporadically (Zingarelli and Karp, 1991:5). As a result, existing billing practices often create disincentives for individual consumers to conserve water or to invest in water conservation technology.

Similarly, there is little incentive for water supply or wastewater treatment authorities to invest in water conservation since their mandate has traditionally been limited to assuring adequate supplies or treatment. In addition, the ability of these authorities to reform the water rate structure is often limited by the absence of accurate metering at the point of water withdrawal and/or at the point of consumption, and, occasionally, by lack of jurisdiction over the metering system itself. In other cases, narrow interpretations of existing legal requirements have effectively blocked efforts to impose water rates that increase with increased water use (inclining rates) (Zingarelli and Karp, 1991:5).

Inconsistent Regulation of WWTFs

Individual wastewater treatment facilities within each state operate under unique physical and regulatory conditions. The physical operation of each facility depends upon when it was built, particularly the technologies available at the time it was built, and when major upgrades were undertaken. In addition, the local industrial and residential base determines the chemical characteristics of the wastewater influent to a WWTF, leading to differences in regulation (such as the establishment of a pretreatment program). Differences in local environmental conditions, such as the characteristics of the receiving water (marine or freshwater, dilution field, *etc.*), also lead to different treatment and effluent limits for each facility.

Since a WWTF permit is effective for five years, each WWTF is regulated according to which regulations apply at the time the facility's operating permit is issued. Therefore, different regulatory requirements can be imposed on neighboring WWTFs discharging to the same receiving water, at least temporarily, as new requirements are phased into effect (Zingarelli and Karp, 1991:7). Although there may in some cases be reasons for treating WWTFs individually, it is important to evaluate by a basinwide approach whether the regulatory requirements are achieving their intended result. However, as a result of the number of regulated WWTFs in the Bay basin, the federal and state regulatory agencies rarely make geographically comprehensive decisions about the cumulative impacts of WWTF discharges to regulated waterbodies. Regionalization of WWTFs could, therefore, be one approach to promote basinwide planning and basinwide regulation of pollutant sources to protect shared waters.

Existing Policies

In Massachusetts, water supply functions have been administered both by the Department of Environmental Management (MADEM) and by the Department of Environmental Protection (MADEP), and wastewater treatment functions primarily by the MADEP. In Rhode Island, a Water

Supply Management Division was established within the Rhode Island Department of Environmental Management (RIDEM) in 1991 by Executive Order. Wastewater treatment facilities are also regulated by the RIDEM. Municipal sewage collection systems are administered by each sewered community in the Narragansett Bay watershed, as mentioned above (Zingarelli and Karp, 1991:1).

Rhode Island's institutional structure for governing the supply and pricing of water is highly complex. Agencies with significant water use responsibilities in the State of Rhode Island include the State Water Resources Board, the Rhode Island Division of Planning (RIDOP), the Department of Health (RIDOH) Division of Water Supply, RIDEM's Divisions of Water Resources, Freshwater Wetlands, and Water Supply Management, and the Public Utilities Commission (PUC) (Zingarelli and Karp, 1991:4). Since water supply and wastewater treatment are managed as unrelated functions by both states, policies affecting water conservation and wastewater treatment are addressed separately, see below.

Water Conservation

Almost 90 percent of Rhode Island's residents rely on water supplied by 30 major water departments. The rates and operating practices of the largest of these 30 water providers are regulated by the PUC. The large number of water suppliers complicates regional planning and cooperation, as stated above, and is an impediment in itself to water conservation (Arthur D. Little, Inc., *et al.*, 1990). The need for water conservation and regional water supply planning have been identified in many recent activities, including the *Water Supply Analysis for the State of Rhode Island* prepared for the Rhode Island Water Resources Coordinating Council in 1990, the establishment of a Water Supply Management Division within RIDEM in 1991, and the draft *Water Supply Plan* completed by the RIDOP in 1992.

Legislation passed by the Rhode Island General Assembly in 1991, however, offers a significant opportunity to improve water conservation. The legislation, based on extensive work by the Narragansett Bay Project, other participants in the "Green Rhode Island" initiative, and the RIDOP, requires water suppliers to complete water supply management plans that consider both *demand management* and *system management* measures to promote water conservation. These might include fee and billing structures, retrofitting water-saving plumbing equipment, effective metering, leak repair and prevention, and public education programs. The law also establishes guidelines for setting fees, rates, and charges that are intended to improve water supply management (R.I.G.L. 46-15.4, as amended; Zingarelli and Karp, 1991:5-6).

WWTF Management

In the early years of the Clean Water Act, state and federal subsidies for WWTFs were provided through the Construction Grants program. This program and its successor, the State Revolving Fund (SRF), include specific federal eligibility requirements for participation in the program. The State of Rhode Island, in funding its SRF, contributed additional state money into the program and established the Clean Water Protection Finance Agency in order to be able to fund projects that might not be eligible under federal requirements. The investment of state funds indicates some public recognition of the *statewide* benefits of wastewater treatment. In addition, the eligibility requirements for SRF loans indicate an appreciation of those projects with the greatest statewide rather than local benefit (Zingarelli and Karp, 1991:8).

Before the Clean Water Act, however, there was a precedent in Rhode Island for regionalizing WWTFs. The Blackstone Valley District Commission (BVDC) was created by the General Assembly in 1947, when lawmakers concluded:

> Economy and efficiency dictate the desirability for an overall plan for dealing with the sewage and industrial wastes which originate in several municipalities and industries located in the Blackstone and

> Moshassuck Valleys... [T]he problem can best be solved by the creation of a state agency for the planning, construction, operation, and maintenance of appropriate facilities (R.I.G.L. 46-21-2).

The act creating the Narragansett Bay Commission (NBC) in 1980 echoed these sentiments, and added:

> [B]ecause of the scope and complexity of the work necessary to correct and minimize these pollution discharges and the scope of financing required, local municipalities in the Providence metropolitan area have been unable alone to cope properly and immediately with the magnitude of the pollution discharges (R.I.G.L. 46-25-2(c)).

In 1991, legislation was passed authorizing the merger of BVDC and NBC in early 1992. The merger statute noted that "economy, efficiency, and technological advances dictate the desirability of having one entity to formulate, coordinate, and regulate an overall plan to reduce the discharge of sewerage and industrial wastes..." (R.I.G.L. 46-25-2(g); Zingarelli and Karp, 1991:8) .

Even so, WWTFs in the Narragansett Bay watershed are, with few exceptions, still owned and operated by the communities in which they are located. The watershed contains 33 regionally or municipally owned WWTFs, operated by 32 separate entities, 15 in Rhode Island and 17 in Massachusetts. Facilities in both Rhode Island and Massachusetts are subject to National Pollutant Discharge Elimination System (NPDES) permit requirements. In Massachusetts, NPDES permits are issued and enforced by the U.S. Environmental Protection Agency (EPA). Concurrently, State discharge permits are issued by the Commonwealth of Massachusetts through MADEP. In Rhode Island, WWTFs must obtain Rhode Island Pollutant Discharge Elimination System (RIPDES) permits, based on the NPDES program but delegated by the EPA to RIDEM. In spite of similar permitting programs and EPA oversight in both Massachusetts and Rhode Island, WWTFs are typically *not* regulated in a consistent manner, either basinwide or statewide (Zingarelli and Karp, 1991:7). For example, the inconsistencies in discharge permit limits for toxic pollutants between WWTFs in Rhode Island and Massachusetts are described in 04-01-01 Source Reduction: Toxics.

Analysis

<u>Water Conservation</u>

The volume of water used for domestic, commercial, and industrial purposes has a direct effect on the water quality of the Bay and its tributary ground and surface waters. Water conservation measures may be necessary in some instances simply to assure adequate water supplies (Arthur D. Little, Inc. *et al.*, 1990). Water conservation efforts should also be pursued to help reduce wastewater load, particularly to OSDSs. The failure rate of OSDSs can be reduced in some cases by reducing the hydraulic load on the leach field, particularly in areas with saturated or poorly drained soils. In addition, reducing wastewater loads can extend the lifetime and lower the capital needs of publicly owned wastewater treatment facilities (WWTFs), if the system is nearing its treatment capacity. Water conservation may result in a less dilute influent load to the WWTF, which in some cases may make effective treatment more difficult to achieve (Zingarelli and Karp, 1991:4).

Rhode Island's recent enactment of water conservation legislation (R.I.G.L. 46-15.4, as amended) provides sufficient authority to the PUC and state management agencies to effectively implement water conservation measures. In support of that legislation, all water suppliers should be required to utilize all feasible and effective water conservation measures prior to developing new sources of water supply or abandoning existing sources. Active water conservation programs could be developed through fee and billing structures; retrofitting of water-saving plumbing equipment, including performance of water audits and installation of devices at cost or no direct cost to users; meter installation, replacement, and reading; leak detection, repair, and prevention; and public education programs, including programs for municipal and state building officials (Zingarelli and Karp, 1991:6).

WWTF Consolidation

Consolidation of publicly owned wastewater treatment facilities may better protect the states' economic and environmental interests for several reasons. First, to the extent that WWTF improvements are financed and partially subsidized through the state-administered revolving loan funds, the public's investment could be better protected by preferentially financing projects based, in part, on their expected statewide benefit. Regional treatment authorities, with their focus on *regional* water quality and facility planning, would have a greater interest in providing benefits to the general public rather than to residents of a narrow geographic region. Basinwide pollution abatement and growth management alternatives would, therefore, be evaluated more objectively, and more consistently implemented (Zingarelli and Karp, 1991:8-9).

In evaluating possible consolidation or regionalization of WWTFs, environmental (*e.g.*, water quality improvements) and economic (*e.g.*, cost savings resulting from operational efficiencies) issues are most important. However, other issues, such as equity considerations in establishing a consistent user fee schedule, must also be considered (Metcalf & Eddy, Inc., 1991c).

- Environmental and Economic Benefits

The environmental and economic benefits to be achieved from consolidation of WWTFs are fundamentally linked. Establishment of a uniform system for managing geographically complex programs (*e.g.*, combined sewer overflow (CSO) abatement) can result in the development of solutions that provide the greatest environmental benefit at the least cost. Similarly, any economic efficiencies achieved from merging programs could result in direct cost savings that could be re-invested into further capital or program improvements. For example, efficiencies could be achieved through consolidation of the labor pool, establishment of a single billing and accounting system, centralization of laboratory, library, and training facilities, and standardization of maintenance programs, including bulk purchases of materials and chemicals (Zingarelli and Karp, 1991:11).

Administrative consolidation of wastewater treatment authorities into a regional or statewide utility could also facilitate the examination of structural solutions to local wastewater treatment and disposal problems. For example, three communities on the Pawtuxet River (West Warwick, Warwick, and Cranston) are each conducting a facility plan to evaluate alternatives for providing advanced wastewater treatment (AWT), under a consent agreement with RIDEM. Although each community is investigating regional AWT alternatives as part of its facility plan, and regional AWT could be implemented without consolidating the three treatment authorities, the facility planning process and any ultimately recommended regional solution would doubtlessly be facilitated through consolidation of the three WWTFs into a Pawtuxet River Treatment Authority. In addition, basinwide pollution abatement and growth management alternatives could most objectively be evaluated and consistently implemented by a regional Pawtuxet River Treatment Authority, rather than by individual communities, which may have a self-interest in recommending community-specific solutions (Zingarelli and Karp, 1991:9).[See "Other Issues" below.]

There are many additional examples of potential environmental advantages from consolidating WWTFs. Consolidated WWTFs may be better able to equalize the utilization of treatment capacity, rather than allowing some plants to operate periodically at or above their design capacity. This approach may also reduce or eliminate some of the WWTF bypasses and CSO discharges that currently occur, if base wastewater loads or storm flows can be transferred to plants with available capacity. Opportunities may also be present for regional solutions to the problem of sludge disposal, through methods such as composting, incineration, or pelletization (Zingarelli and Karp, 1991:10).

Administrative consolidation of treatment authorities may also directly lead to environmental benefits. An authority's management structure and other institutional constraints, such as a mismatch between its treatment requirements and financial capabilities, may result in its failure to comply with permit conditions (University of Rhode Island Intergovernmental Policy Analysis Program, 1990). Consolidation of authorities with severe financial constraints or ineffective management structures into those with financial capability and effective management could result in direct water quality improvements, or cost savings that could be reinvested into such improvements (Zingarelli and Karp, 1991:11).

Consolidation should also promote the standardization of several programs. In these cases, while direct environmental benefits may be difficult to document, more effective regulatory programs would result, thus producing indirect environmental benefits. Examples of programs that could be improved with standardization include the industrial pretreatment program and septage disposal programs (Zingarelli and Karp, 1991:12).

It is also likely that consolidation would result in a significantly reduced workload for facility staff. A reduction in the number of RIPDES/NPDES discharge permits — with an associated reduction in mailings, public hearings, discharge monitoring reports, *etc.*, — would be one instance where the workload of state and federal regulators would be reduced as well (Zingarelli and Karp, 1991:12).

- Equity Issues

User fees vary widely between existing authorities. This may be due to the different costs for providing treatment, in some cases at different treatment levels, from one authority to the next. On the other hand, some sewer authorities recover debt service and other costs through the general property tax rate rather than through user fees. As part of any consolidation, a consistent schedule to recover all operating and capital costs from user fees, varying strictly with the cost of treatment or other characteristics of the service subarea, would have to be established system wide. However, residents of those communities that currently have relatively low user fees because the cost of treatment is subsidized by property taxes might consider such a system inequitable, particularly if not accompanied by a corresponding decrease in property taxes (Zingarelli and Karp, 1991:12-13).

A related equity issue to be considered would be the issue of debt retirement. Communities have varying levels of outstanding debt service, related to the time when major construction was last undertaken (Metcalf & Eddy, Inc., 1991c). An equitable arrangement of retiring debt would have to be established so that those communities with low remaining outstanding debt would not be penalized (Zingarelli and Karp, 1991:13).

In Rhode Island, regulation of consolidated treatment authorities through the PUC may be an appropriate channel for resolution of such financial and equity issues. The PUC is charged with providing "fair regulation of public utilities and carriers in the interest of the public." (R.I.G.L. 39-1-1(b)) Although existing authority of the PUC over wastewater treatment authorities is currently limited to the NBC, expansion of PUC authority to other regional wastewater treatment authorities would likely prove the most effective means of resolving interjurisdictional issues regarding rate and debt equity (Zingarelli and Karp, 1991:13).

- Other Issues

One political impediment to consolidation may be a desire by communities to retain control of their WWTFs. Those communities with an effective management structure may be reluctant to relinquish control to a regional authority, as well as having to assume costs for improvement of the more poorly-run plants (Metcalf & Eddy, Inc., 1991c). Similarly, regional planning and siting for "undesirable" facilities (*e.g.*, sludge incinerators) may result in certain member communities considering themselves to be unfairly treated.

Additionally, individual communities may consider control over lateral sewers an important tool in planning and management of growth. The issue of whether control of lateral sewers should be transferred to a regional authority should also be investigated as part of an analysis of the feasibility and desirability of WWTF consolidation (Zingarelli and Karp, 1991:12).

Recommended Policies and Actions and *Estimated Cost of Implementation* are presented in the following pages.

CODE	POLICY	AGENCIES	STATUS
I.	The State of Rhode Island should maximize conservation of its water supplies in order to minimize the volume of wastewater generated and ultimately discharged to Narragansett Bay and its tributaries.		
I.A.	The Rhode Island Department of Environmental Management (RIDEM) Division of Water Supply Management, the Rhode Island Department of Health (RIDOH) Division of Drinking Water Quality, the Rhode Island Department of Administration Division of Planning (RIDOP), the Division of Public Utilities, and the Public Utilities Commission (PUC) should actively enforce the requirements of the Water Supply Management Act of 1991 (R.I.G.L. 46-15.4, as amended by P.L. 1991, ch. 311).	RIDEM, RIDOH, RIDOP, PUC	[See RIDOP and RIDOH "Preliminary Agreements," Section 715-05-06.]
I.B.	These agencies should ensure that all water suppliers develop active water conservation programs through: 1. Fee and billing structures; 2. Retrofitting of water-saving plumbing equipment, including performance of water audits and installation of devices at cost or no direct cost to users; 3. Meter installation, testing, replacement, and reading for domestic, commercial, and industrial users; 4. Leak detection, repair, and prevention; 5. Public education programs, including programs for municipal and state building officials; and 6. Other feasible water conservation measures.	RIDEM, RIDOH, RIDOP, PUC	
I.C.	These agencies should evaluate whether consolidation of water supply authorities may be an appropriate measure to enhance water conservation efforts or to effect other water quality improvements, either directly or indirectly.	USGS, RIDEM, RIDOH, RIDOP, PUC	[See USGS and RIDEM "Preliminary Agreements," Section 715-05-06 re: development of a water use database to evaluate demand on water supplies, and effect on wastewater treatment.]
I.D.	All water suppliers should be required to utilize all feasible and effective water conservation measures, including those listed above, prior to developing new sources of water supply or abandoning existing sources. Water suppliers should utilize sources within their watershed prior to utilizing out-of-basin transfers for water supply.	RIDEM, RIDOH, RIDOP, PUC, Water Suppliers	

✓ - High Priority Action

CODE	POLICY	AGENCIES	STATUS
II.	The State of Rhode Island should maximize the economic and administrative efficiency of the State's wastewater treatment facilities (WWTFs) in order to more effectively protect Narragansett Bay and its tributaries from the effects of wastewater treatment and disposal.		
II.A.	The State of Rhode Island should establish a commission to evaluate the feasibility of consolidating its WWTFs. The commission should determine whether such consolidation, if feasible, should consist of: 1. Individual consolidation measures (*e.g.*, incorporation of the Smithfield and East Providence sewer districts into the Narragansett Bay Commission (NBC); merger of the West Warwick, Warwick, and Cranston sewer districts); or 2. Establishment of a few regional wastewater treatment authorities based on political subdivision boundaries (*e.g.*, by county), or based on watershed boundaries (*e.g.*, Upper Bay, West Bay, East Bay, coastal); or 3. Establishment of a statewide wastewater treatment authority by phasing individual consolidations to regional authorities and, eventually, to a single state authority.	State of R.I.	NBC-BVDC officially merged in January 1992. RIDEM is requiring Cranston, Warwick and W. Warwick to consider regional options for achieving advanced treatment requirements in the Pawtuxet River.
II.B.	The commission should also examine: 1. The feasibility of forming a combined authority (or authorities, if regional consolidation is recommended) to manage both wastewater treatment and water supply; and 2. The desirability of bringing regional treatment authorities under the regulation of the PUC.	State of R.I.	[See USGS "Preliminary Agreement," Section 715-05-06 re: development of a water use database to evaluate demand on water supplies, and effect on wastewater treatment.]

✓ - High Priority Action

RECOMMENDED POLICIES AND ACTIONS
SOURCE CONTROL: WATER MANAGEMENT AND WASTEWATER TREATMENT

CODE	POLICY	AGENCIES	STATUS
II.C.	The commission should consider the following issues in evaluating the aforementioned consolidation alternatives: 1. Environmental effects of WWTF consolidation, including: a. Feasibility of regional CSO abatement measures; b. Feasibility of regional treatment alternatives (*e.g.*, advanced wastewater treatment); c. Feasibility of regional pretreatment, sludge disposal, and effluent reuse programs; d. Probability of achieving improved wastewater treatment through effective management and financial capabilities; and e. Availability of additional funding for environmental improvements as a result of economic savings (see below). 2. Economic effects of WWTF consolidation, including: a. Personnel consolidation; b. Centralized billing and accounting system; c. Centralized laboratory, library, and training center; d. Pooling or bulk purchase of equipment and materials; and e. Uniformity of maintenance programs. 3. Other effects of WWTF consolidation, including: a. Standardization of programs; b. Community control of WWTFs and lateral sewers; c. User fee schedules and debt retirement; and d. Desirability of placing WWTFs under PUC authority.	State of R.I.	
II.D.	In addition, the commission: 1. Should recommend whether the following structural regionalization alternatives should be technically evaluated through the facility planning process: a. Consolidation of East Greenwich and Quonset Point WWTF discharges to a new deepwater outfall at Quonset Point; b. Consolidation of Narragansett Bay Commission Bucklin Point (formerly BVDC) and East Providence WWTF discharges to a single discharge at East Providence. 2. Should <u>not</u> consider a facility plan for a consolidated marine outfall off Point Judith unless new scientific information is developed on the potential water quality impacts of such a project on Narragansett Bay and Rhode Island Sound.	State of R.I.	

✔ – High Priority Action

Estimated Cost of Implementation - Source Control: Water Management and Wastewater Treatment

Table 715-04(3) summarizes the estimated costs associated with implementing the recommendations in this chapter. Element I (Water Conservation) requires State agencies to actively enforce the use of water conservation measures by the State's water suppliers prior to the development of new drinking water supply sources or the abandonment of existing sources. The costs involved ($100,000) are spread out evenly over the five-year planning period. Element II (WWTF Consolidation) recommends the creation of a commission to evaluate the feasibility of establishing a regional or statewide wastewater treatment authority. This would occur in 1994-95 and would conclude in the following year. Both Elements require coordination activities between the major State agencies (RIDEM, RIDOH, and RIDOP) and municipalities.

Although the NBP actively supported the action, the costs associated with consolidating the NBC and BVDC WWTFs have not been included because the merger became official prior to completion of the *CCMP*. Similarly, the costs associated with the upgrade of the Cranston, Warwick, and West Warwick WWTFs on the Pawtuxet River have not been included since the action was mandated by RIDEM independently of the *CCMP*. However, RIDEM's most recent estimate (June 1992) of the capital costs associated with the upgrade of the individual WWTFs is: Cranston, $30 million; Warwick, $25 million; and West Warwick, $20 million. Consistent with the recommendations in this chapter, a regional solution may be more cost-effective to the extent that these communities seek partial state financing from the Rhode Island Clean Water Protection Finance Agency (RICWPFA) or another state revenue source in order to complete the advanced treatment projects.

For further details regarding the *CCMP* cost estimation process and funding strategies, refer to the *Narragansett Bay CCMP Cost Estimation and Funding Report* (Apogee Research Inc./NBP, 1992).

Table 715-04(3)

ESTIMATED COST OF IMPLEMENTATION
SOURCE CONTROL: WATER MANAGEMENT AND WASTEWATER TREATMENT

COST ESTIMATES BY ELEMENT	92-93		93-94		94-95		95-96		96-97		Total 92-97	
	Personnel	Other	Personnel	Other	Personnel	Other	Personnel	Other	Personnel	Other	Personnel	Other
I-Water Conservation	20,000	0	20,000	0	20,000	0	20,000	0	20,000	0	100,000	0
II-WWTF Consolidation	0	0	0	0	26,250	0	25,000	0	0	0	51,250	0
TOTALS	20,000	0	20,000	0	46,250	0	45,000	0	20,000	0	151,250	0
TOTAL BY YEAR		20,000		20,000		46,250		45,000		20,000		151,250

COST ESTIMATES BY AGENCY	92-93		93-94		94-95		95-96		96-97		Total 92-97	
	Personnel	Other	Personnel	Other	Personnel	Other	Personnel	Other	Personnel	Other	Personnel	Other
RIDEM	5,000	0	5,000	0	11,250	0	10,000	0	5,000	0	36,250	0
RIDOH	5,000	0	5,000	0	5,000	0	5,000	0	5,000	0	25,000	0
RIDOP	5,000	0	5,000	0	10,000	0	10,000	0	5,000	0	35,000	0
RI PUC	5,000	0	5,000	0	5,000	0	5,000	0	5,000	0	25,000	0
RI Governor's Office	0	0	0	0	5,000	0	5,000	0	0	0	10,000	0
RI Municipalities*	0	0	0	0	5,000	0	5,000	0	0	0	10,000	0
WWTFs	0	0	0	0	5,000	0	5,000	0	0	0	10,000	0
TOTALS	20,000	0	20,000	0	46,250	0	45,000	0	20,000	0	151,250	0
TOTAL BY YEAR		20,000		20,000		46,250		45,000		20,000		151,250

* Ultimate implementation costs will vary for each municipality depending on its particular environmental and institutional conditions. In addition, the estimated municipal implementation costs do not include ultimate program and capital costs that may result from completion of underlying planning activities, or costs that are expected to be completely recoverable from user fees.